

OUTLINE SHEET 3-10-1

Shipboard Electrical Equipment

A. Introduction

The production and distribution of electricity onboard the ship is vital for its ability to meet operational commitments

B. Enabling Objectives

3.26 **DEFINE** electrical terms.

3.27 **EXPLAIN** basic concepts of electricity.

3.28 **DESCRIBE** the major components of the shipboard power distribution system.

3.29 **STATE** the safety precautions used in the vicinity of electrical equipment.

C. Topic Outline

1. Introduction
2. Definition of Terms
3. AC Generators
4. Power Distribution
5. Motor Controllers
6. Shore Power
7. Summary and Review
8. Assignment

ASSIGNMENT SHEET 3-10-2
Shipboard Electrical Equipment

A. Introduction

This material is to be completed prior to the material being covered in class.

B. Enabling Objectives

Refer to enabling objectives in Outline Sheet 3-10-1.

C. Study Assignment

1. Read Fireman NAVEDTRA 12001, pages 12-1 to 12-15.
2. Read Information Sheet 3-10-3

D. Study Questions

1. (True/False) A wire with a high ohm value would allow more current to flow through than a wire with a low ohm value.
2. What causes current to flow through in a conductor?
3. What is used to create a magnetic field in a generator?
4. What is/are the purpose(s) of circuit breakers?

INFORMATION SHEET 3-10-3

Shipboard Electrical Equipment

A. Introduction

This information describes basic concepts and safety precautions associated with shipboard power generation and use.

B. Reference

Fireman NAVEDTRA 12001
Machinist's Mate 3&2 NAVEDTRA 12144
Electrician's Mate NAVEDTRA 12164

C. Information

I. DEFINITION OF TERMS

- A. A conductor is a material that offers low resistance to current flow.
- B. An insulator is a material that offers high resistance to current flow.
- C. Electrical resistance is the property of a material that opposes the flow of current. The unit of measurement for resistance is the ohm (Ω).
- D. Electric current is the rate at which electricity flows through a conductor or circuit past a reference point. Ampere or amp is the unit of measure for electrical current.
 - 1. Alternating Current (AC) is electrical current that reverses direction in a circuit at regular intervals.
 - 2. Direct Current (DC) is electric current that flows in one direction.
- E. Electromotive Force (EMF) is the force that causes current to flow through an electrical conductor.
 - 1. EMF is measured in volts.
 - 2. Increasing the voltage in a conductor will increase the current.
- F. Power is the rate of doing work.
 - 1. It is measured in watts.
 - 2. A watt is 1 amp of current flowing through a resistance of 1ohm.

II. Shipboard conditions contribute to the danger of electrical shock.

- A. The severity of shock may be increased because your body is likely to be in contact with the ship's metal structure. Your body's resistance may be low because of perspiration or damp clothing.
- B. The following are posted in the vicinity of the switchboards and power panels:
 - 1. Safety precautions
 - 2. Operating instructions

3. Wiring diagrams
 4. Artificial respiration instructions
 - C. "DANGER HIGH VOLTAGE" signs are posted by all access doors to the main distribution switchboards.
- III. All AC generators operate on the same principle. To produce or generate electricity, the following three elements must be present:
 - A. A magnetic field - this is created by using a permanent magnet or electromagnet.
 - B. Conductors - the wires or winding where the output voltage is generated
 - C. Motion - All generators require a prime moving force to rotate the magnetic field or the conductors. This rotary motion may be furnished by:
 1. gas or steam turbines
 2. combustion engines
 3. electric motors
- IV. The distribution switchboards connect the generators to load centers, power panels, and the various equipment that uses it.
 - A. A switchboard is panel or group of panels that distributes electrical power throughout the ship.
 - B. The number and location of ship service switchboards depend on the main machinery compartmentation as well as the number and location of ship service generators.
 - C. Switchboards contain:
 1. Generator circuit breakers used to connect ship's service generators to the power distribution system.
 2. Controls for the operation of the switchboard and the generator it is directly connected to.
 3. Measuring instruments and indicating devices for the switchboard and its generator
 4. bus ties used to interconnect switchboards so that one switchboard can feed power from its generator to one or more switchboards. Bus Tie Breakers are used to interconnect bus ties
 5. Circuit breakers are used to:
 - a) isolate faulty circuits
 - b) protect against over-current conditions
 - c) provide a means to mechanically disconnect the electrical power for equipment maintenance
 - D. Switchboards are usually located near the generators they serve.
- V. Loadcenters are installed on most ships to supply power to groups of equipment.
 - A. They are located near the equipment they feed.
 - B. They may supply power directly to the equipment, or they may feed power panels.

- C. The number and location of loadcenters depend on the size and type of ship, as well as the number and location of ship service generators.
- VI. Power panels provide for control of selected portions of equipment that are located in close proximity to each other. Power panels can feed other power panels or feed equipment directly.
- VII. Motor controllers are used to start or stop, increase or decrease a motor's speed, reverse its direction of rotation, or protect a motor from damage.
 - A. Some will provide overload protection when the motor current is too high.
 - B. Some will provide for low voltage with either:
 - 1. Low-voltage protection(LVP)
 - a) When the supply voltage to a LVP controller is reduced or lost, the motor is disconnected from the power supply.
 - b) Upon restoration of power, the motor will NOT start until you manually depress the start push button.
 - 2. Low-voltage release(LVR).
 - a) When the supply voltage is reduced or lost, an LVR controller disconnects the motor from the power supply.
 - b) When power returns to normal, the LVR will automatically restart the motor.
- VIII. Bus transfers are used to switch power sources from normal to an alternate source.
 - A. Manual Bus Transfer (MBT) - the watchstander must manually flip the switch to change power sources. Normally has an interlock bar so only one power source can be selected at a time.
 - B. Automatic Bus Transfer (ABT) - designed to transfer automatically from the normal to the alternate power source.
 - 1. Automatic operation is accomplished when the normal supply voltage drops.
 - 2. Upon restoration of the normal voltage, most ABTs will automatically transfer back to their normal source of power.
- IX. Shore power is a means of supplying electrical power to a ship from an external source.
 - A. A shore power station is made up of shipboard receptacles, where portable shore power cables from the pier or a ship are attached.
 - B. Shore power enters the distribution system through a shore power breaker.
- X. Motors are devices that convert electrical energy to mechanical energy. Motors can be connected to pumps or generators to be used as the prime mover. The two types of motors are:
 - A. Direct Current (DC) motors
 - B. Alternating Current (AC) motors

DIAGRAM SHEET 3-10-4
Electrical Distribution

